TMM017– CALCULUS I & II SEQUENCE
8-10 Semester Hours/15 Quarter Hours

Related TAGs: AACM Engineering, Bioengineering, Chemical Engineering, Chemistry, Electrical Engineering, Industrial Engineering, Mathematics, Physics

This sequence OTM is a combination of the outcomes in TMM005 and TMM006

TMM005 -CALCULUS I
4-5 Semester Hours/8-10 Quarter Hours

Related TAGs: AACM Engineering, Biology, Bioengineering, Chemical Engineering, Chemistry, Economics, Electrical Engineering, Industrial Engineering, Math, Physics

In a Calculus I course, students should:

- develop mathematical thinking and communication skills and learn to apply precise, logical reasoning to problem solving.
- be able to communicate the breadth and interconnections of the mathematical sciences through being presented key ideas and concepts from a variety of perspectives, a broad range of examples and applications, connections to other subjects, and contemporary topics and their applications.
- experience geometric as well as algebraic viewpoints and approximate as well as exact solutions.
- use computer technology to support problem solving and to promote understanding, as most calculus students, especially those who may take only one semester, profit from the use of a graphing utility and a tool for numerical integration.
- for students in the mathematical sciences, progress from a procedural/computational understanding of mathematics to a broad understanding encompassing logical reasoning, generalization, abstraction, and formal proof; gain experience in careful analysis of data; and become skilled at conveying their mathematical knowledge in a variety of settings, both orally and in writing.

– Adapted from the MAA/CUPM 2004 Curriculum Guide

The prerequisite for Calculus I is generally by placement, TMM002 (Precalculus) or by a sequence of TMM001 and TMM003 (College Algebra and Trigonometry, respectively).

To qualify for OTM equivalency of TMM005 (Calculus I), a course must cover as a minimum the essential learning outcomes, denoted by an asterisk (*). A Calculus I course may also commonly include some of the listed nonessential learning outcomes. These optional topics should be included only if there is adequate course time to do so beyond giving primary course attention to the essential learning outcomes. At least 70% of the classroom instructional time has to be spent on the essential learning outcomes. The optional learning outcomes are learning experiences that enhance, reinforce, enrich or are further applications of the essential learning outcomes. If review of prerequisite course content is necessary, only a minimal amount of time should be devoted to such review.

The successful Calculus I student should be able to apply the following competencies to a wide range of functions, including piecewise, polynomial, rational, algebraic, trigonometric, inverse trigonometric, exponential and logarithmic:

1. **Determine the existence of, estimate numerically and graphically and find algebraically the limits of functions. Recognize and determine infinite limits and limits at infinity and interpret them with respect to asymptotic behavior.***

2. **Determine the continuity of functions at a point or on intervals and distinguish between the types of discontinuities at a point.***

3. **Determine the derivative of a function using the limit definition and derivative theorems. Interpret the derivative as the slope of a tangent line to a graph, the slope of a graph at a point, and the rate of change of a dependent variable with respect to an independent variable.***

4. **Determine the derivative and higher order derivatives of a function explicitly and implicitly and solve related rates problems.***

5. **Determine absolute extrema on a closed interval for continuous functions and use the first and second derivatives to analyze and sketch the graph of a function, including determining intervals on which the graph is increasing, decreasing, constant, concave up or concave down and finding any relative extrema or inflection points. Appropriately use these techniques to solve optimization problems.***

6. Determine when the Mean Value Theorem can be applied and use it in proofs of other theorems such as L'Hopital's rule.

7. Use differentials and linear approximations to analyze applied problems.

8. **Determine antiderivatives, indefinite and definite integrals, use definite integrals to find areas of planar regions, use the Fundamental Theorems of Calculus, and integrate by substitution.***

TMM006 - CALCULUS II
4-5 Semester Hours/8-10 Quarter Hours

Related TAGs: AACM Engineering, Bioengineering, Chemical Engineering, Chemistry, Electrical Engineering, Industrial Engineering, Mathematics, Physics

In a Calculus II course, students should:

- develop mathematical thinking and communication skills and learn to apply precise, logical reasoning to problem solving, as emphasized in the calculus renewal movement.
- be able to communicate the breadth and interconnections of the mathematical sciences through being presented key ideas and concepts from a variety of perspectives, a broad range of examples and applications, connections to other subjects, and contemporary topics and their applications.
- experience geometric as well as algebraic viewpoints and approximate as well as exact solutions.
- use computer technology to support problem solving and to promote understanding (e.g., technology allows students easy access to the graphs of planar curves and visualization helps students understand concepts such as approximation of integrals by Riemann sums or functions by Taylor polynomials; symbolic manipulation can be handled allowing students to focus their attention on understanding concepts; computer algorithms can be explored; and conjectures can be posited, investigated and refined, such as manipulating parameters on classes of functions and fitting functional models to data).
- for students in the mathematical sciences, progress from a procedural/computational understanding of mathematics to a broad understanding encompassing logical reasoning, generalization, abstraction, and formal proof; gain experience in careful analysis of data; and become skilled at conveying their mathematical knowledge in a variety of settings, both orally and in writing.

– Adapted from the MAA/CUPM 2004 Curriculum Guide

The prerequisite for Calculus II is generally by TMM005 Calculus I.

To qualify for OTM equivalency of TMM006 (Calculus II), a course must cover as a minimum the essential learning outcomes, denoted by an asterisk (*). A Calculus II course may also commonly include some of the listed nonessential learning outcomes. These optional topics should be included only if there is adequate course time to do so beyond giving primary course attention to the essential learning outcomes. At least 70% of the classroom instructional time has to be spent on the essential learning outcomes. The optional learning outcomes are learning experiences that enhance, reinforce, enrich or are further applications of the essential learning outcomes. If review of prerequisite course content is necessary, only a minimal amount of time should be devoted to such review.

The successful Calculus II student should be able to:

1. **Use antiderivatives to evaluate definite integrals and apply definite integrals in a variety of applications to model physical, biological or economic situations. Whatever applications (e.g. determining area, volume of solids of revolution, arc length, area of surfaces of revolution, centroids, work, and fluid forces) are chosen, the emphasis should be on setting up an approximating Riemann sum and representing its limit as a definite integral.***

2. Approximate a definite integral by the Trapezoidal Rule and Simpson's Rule.

3. **Employ a variety of integration techniques to evaluate special types of integrals, including substitution, integration by parts, trigonometric substitution, and partial fraction decomposition.***

4. **Evaluate limits that result in indeterminate forms, including the application of L'Hôpital's Rule.***

5. **Evaluate improper integrals, including integrals over infinite intervals, as well as integrals in which the integrand becomes infinite on the interval of integration.***

6. Find, graph, and apply the equations of conics, including conics where the principal axes are not parallel to the coordinate axes.

7. **Determine the existence of, estimate numerically and graphically, and find algebraically the limits of sequences. Determine whether a series converges by using appropriate tests, including the comparison, ratio, root, integral and alternating series tests.***

8. **Find the n^{th} Taylor polynomial at a specified center for a function and estimate the error term. Use appropriate techniques to differentiate, integrate and find the radius of convergence for the power series of various functions.***

9. **Analyze curves given parametrically and in polar form and find the areas of regions defined by such curves.***

10. Perform and apply vector operations, including the dot and cross product of vectors, in the plane and space.

11. Solve separable differential equations. Understand the relationship between slope fields and solution curves for differential equations. Use Euler's method to find numerical solutions to differential equations.